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TEACHING CORN PRODUCTION IN SECONDARY SCHOOLS.

INTRODUCTION.

Corn is the most important contribution of America to the food supply of the world. In the United States at the present time the corn crop is more valuable than any two other crops. The popularity of corn with the American farmer is due to the fact that it will adapt itself to a great variety of conditions and yield more food per acre than any other grain crop. The agricultural importance of this crop has given it a prominent place in the teaching of agriculture. Although there is a wealth of published material pertaining to corn in the teaching of elementary agriculture, and a number of special books intended primarily for college use, there are few publications intended to fit the subject with secondary courses. It is the aim of this article to suggest methods of teaching the subject in a secondary course where the vocational aim predominates.

RELATION OF SUBJECT TO COURSE OF STUDY.

Relation to general agriculture.—In many schools general courses are given in which the imparting of agricultural information is the chief aim. As corn is one of the leading crops, usually a number of lessons are devoted to this subject. In applying the vocational aim to such a course, in regions where corn is the leading crop, a large share of the time should be given the subject as a means of applying the principles of plant production. Students in such a course should be required to grow half an acre or more of corn in connection with the study of the subject. In rounding out such a general course, and in finding application for the principles of animal husbandry, each student may keep one or more calves or pigs. Swine or baby beef will fit very well with corn production, and through the two kinds of projects many of the general principles and practices of agriculture may be worked out.

Relation to courses in agronomy.—In four-year courses in agriculture usually a general course in agronomy or a course in field crops is given. In such a course more extensive study may be given those crops important in the district. In corn-growing sections a student may grow one or more acres of corn and center his attention for the season upon the one project. Where animal husbandry follows the course in farm crops, an animal project should follow the crop project. It may be advisable for the student to continue his corn production as a source of feed for his animals.

Seasonal sequence.—As the production of corn involves work mostly during the growing season, much of the work comes when school is not in session. The topics should be considered, however, in seasonal order as far as possible. After school opens in the fall the class may begin with seed selection in the field, following with methods of harvesting and marketing. Such work as the making of seed racks and testers and the judging and care of seed corn may be done by the students in the winter. Preparation of the land, planting, and the care and cultivation of the crop should be considered in the spring.

Correlation with other subjects.—(1) *With other agricultural courses.*—In considering the feeding value of corn and the production and making of silage there should be close correlation of the subject with animal husbandry and dairying. If another class is taking farm mechanics, the two classes may make a study of corn implements and machinery at the same time. In making appliances for corn production in the shop, there should also be cooperation between the class in farm crops and the class in farm mechanics or mechanic arts. (2) *Science courses.*—Corn production involves the application of all the sciences commonly taught in the high school. From one point of view it would be better to teach the subject in the fourth year after the students have had courses in science; the teacher would then merely have to review scientific principles in their application to corn production. As the subject is usually taught in the first or second years, it is necessary for the agricultural instructor to give more time to the essentials of science involved. If the students are taking a course in general science at the same time they are studying crops, there is a very good opportunity for cooperation and correlation. The production of corn will involve the application of botany in considering the corn plant, how it grows and reproduces, and its relation to other plants. In considering the soil in which the plant grows and the effect of climate upon growth, physical geography is involved. Corn pests and their control call for an application of zoology. In discussing corn as human food, principles of physiology and home economics are involved. A consideration of soil fertility and fertilizers and the composition and growth of corn must be based upon some knowledge of chemistry. An intelligent understanding of the nature of the soil, the movement of liquids in the soil and in the plant, and the relation of the plant to light, heat, and other phases of its physical environment is based upon a knowledge of physical laws. Principles of elementary physics may also be reviewed and applied in considering the mechanics of corn machinery. As the principles of plant production are but an application of the principles of general science to a phase of agriculture, the teacher of agriculture should take an active interest in the science which his students are being taught that he may not duplicate work already given and that he may not assume that his students have had instruction which they have not received. It should be unnecessary to add that other teachers should have an interest in the agricultural classes that there may be mutual aid given and that correlations will be reciprocal as far as possible. (3) *Other subjects.*—Corn production has such an intimate connection with country life in a large section of the United States that it may well furnish themes for English, problems for mathematics, and material for music and art. Courses in economics should consider such topics as the relation of corn production and supply to its distribution and use. As regions where the one-crop system prevails in corn production have peculiar social problems, the subject will also have a bearing upon rural sociology. In many of the rural schools of the Corn Belt progressive teachers are connecting the greater part of their instruction in some way with the leading crop, as it is such an important factor in the lives of the people. Although secondary schools reach out in a broader way in their teaching, they should connect their work with the home work of their students to a greater extent.

Adaptation to secondary students.—If the production of corn is considered in the elementary school, what will remain for the secondary students to study? To answer that the growing of corn involves a great many of the principles of plant production and that the subject can not be exhausted in the elementary school does not suffice. Teachers desire to know the difference between elementary and secondary agriculture. The difference is not so much in the subject matter taught as in the method of approach and the extent of its treatment. Secondary students have reached an age where they can not only learn better how to do a thing, but they have also developed the power to reason, so that they may better learn why. When practical agriculture is correlated with the principles of science the students will be able to answer many

questions which came to their minds as children and which come in even greater numbers in adolescence. If the students are not to be bored by a continuation of the subject it must be approached from new angles. Interest can not be maintained if there is much repetition of facts once learned. If the elements of production have been considered in the elementary course there will be more time in the secondary school to devote to such problems as the improvement of the crop and the maintenance of soil fertility. If the students have learned how to test seed in the rural school, do not repeat the work as given there, but have them try out the efficiency of different forms of testers. Emphasize the practical bearing of all topics and in all practical work strive for increased efficiency. If the students have had some work in selecting ears, endeavor to build upon that foundation in making them expert judges.

Adaptation to community.—The course should be adapted to the particular needs of the district served by the school. In order that the instructor may have accurate information as to the extent of corn production and the methods used he should have the students assist him in making a survey of corn production. If this survey is made carefully it will assist in arousing interest as well as furnishing a basis for adaptation to local conditions. The following is suggestive of a report form to be used in securing information.

Corn survey.

No.	Name of farmer.	Location of field.	Purpose for which grown.	Acres.	Yield.	Special methods.
1.....
2.....
3.....
Etc.....

CLASSROOM INSTRUCTION.

Use of texts and references.—It should be obvious that if the subject is to be adapted to both the students and community a textbook can not be followed slavishly. In making adaptations State publications and the bulletins of this department may be used to advantage. The teacher will find the recent editions of books devoted entirely to corn helpful for his personal use and for students who may be assigned special topics. Students having an interest in special phases of corn production, such as the production of pop corn, sweet corn, or corn for silage, may be assigned these subjects as special topics for written reports to the teacher or oral reports to the class. Topics such as the history of corn, methods of marketing, and the manufacture of corn products, which the entire class may not have time to study extensively, may be assigned also as special topics.

Lesson outlines.—In order that time may be properly distributed and subjects given proper emphasis the teacher should make an outline covering the entire course. When it has been determined how much time there will be for a study of corn, each lesson should be outlined in a definite way, to be taken up according to season. Such outlines aid in holding both the teacher and student in the subject and in giving proper emphasis to topics. Such lesson outlines, if brief, may be placed upon the blackboard or they may be mimeographed and a copy furnished each student. The project-study outline given in connection with the home project will suggest general topics to be considered. These topics are arranged according to a logical rather than a seasonal sequence, as the seasonal adaptation will depend upon local conditions. This outline is necessarily brief and general and must be adapted to each school; it may be placed in the hands of the students in substitution for the teacher's lesson outlines where the majority of the students have a corn project.

USE OF ILLUSTRATIVE MATERIAL.

In the field.—In many respects the best place to study corn is in the cornfield. Opportunity should be sought to observe the growing of the plant under natural conditions. Field trips may be planned in the spring to study methods of soil preparation and planting. The class should become familiar with the working of modern planting machinery. In the fall trips may be made to study the working of harvesting machines. Although growth has stopped at this season, it is a good time to study the effects of different methods of planting and culture. Each trip should be planned with a definite aim and each student should be required to take notes and make a written report. Students should be given every encouragement to make individual observations in the field and to report such studies to the teacher or to the class. As the growth of corn takes place mostly during the time of summer vacation, special inducement should be made to get students to study corn and methods of cultivation at this time, even though they may

not have a corn project. Students should be required in the class recitation and in written papers to report methods used on the home farm.

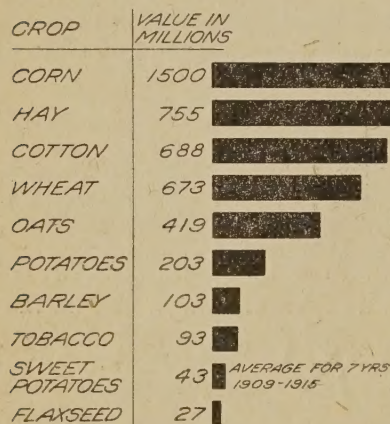


FIG. 1.—Chart showing value of important crops in the United States.

In the classroom.—It is often more convenient to bring material into the classroom than to study it in the field. The school should be provided with an abundance of concrete material and have a place to keep it safe from mice and other pests. Specimens should be available to show the different types of corn and the leading varieties which are suitable to the district. Sample ears showing corn of different degrees toward perfection should be available for judging purposes.

Such material may be supplemented with good illustrations showing the growth of the plant as well as types and varieties. Drawings and diagrams may be made upon the blackboard to assist the student in visualizing the lesson. A chart similar to the one showing the relative value of corn (fig. 1) may be drawn to show the production of corn by States, or this may be shown with dots upon an outline map of the United States.¹ Diagrams of kernels of corn showing the composition of different varieties and strains are included in some of the State publications. Such diagrams may also be copied on the blackboard. Permanent charts of convenient form may be made by using a rubber stamping outfit upon light-colored window shades. Fasteners may be fixed upon the wall to hold the chart; then when it is needed no longer it may be rolled up and put out of the way.

PRACTICUMS.

Care of seed corn.—This work should involve (1) the field selection of ears, (2) the making of seed-corn racks, and (3) the mounting, stringing, and care of the seed corn in curing. In some localities the field selection of corn may be postponed until the students have had training in judging. In sections where there is danger of early frost it will be better to select the corn early and then take up judging in a more extensive way later. If it can be arranged it will be a good plan for the class to undertake the selection and care of the seed corn for a farmer near by. Any of the work may be required as home practicums if it can not be done at the school. The teacher should aim toward deftness and efficiency in every operation involved. Each student

¹ See Thirteenth Census of the United States (1910), Vol. V, Agriculture, for statistics on corn production and for suggestions as to showing statistics in graphic form. See also U. S. Dept. Agr., Bureau of Statistics Bul. 78 (1910), Agricultural Graphics, for maps showing production of crops and live stock in the United States and in the world. This publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 15 cents. For the latest agricultural statistics with graphic illustrations see Appendix of Yearbook of the Department of Agriculture, 1915. Separate 681.

should be required to select and mount at least 10 ears. The contest idea may be utilized to advantage in developing skill in stringing ears. Each student should aid in making both wire and wooden racks. Directions for carrying out the work suggested may be obtained from Farmers' Bulletin 415, Seed Corn.

Testing seed corn.—Each student should be required to test for germination the seed of 10 ears of corn according to each of the following methods: (1) The sand tray, (2) the sawdust box, and (3) the rag doll. Directions for conducting a germination test according to the first two methods will be found in Farmers' Bulletin 253, The Germination of Seed Corn.

The rag-doll tester which has become popular in connection with school work may be made according to the following directions:

(1) Cut a strip of muslin 9 by 54 inches and mark it off into 20 squares $2\frac{1}{2}$ by $2\frac{1}{2}$ inches leaving a margin of 2 inches on each side and a space 9 by $14\frac{1}{2}$ inches at each end as shown in figure 2. Three yards of muslin will thus make eight testers.

(2) Place the 10 (or 20) ears to be tested in a row and select 6 kernels from each ear, replacing the ear in its order. The kernels should be taken from opposite sides near the butt, near the middle, and near the tip, but no two from the same row. They should be placed in the numbered squares, according to the order of the ears, with germs upward and tips all pointing in one direction. It is advisable to dip the cloth in warm water before placing the kernels upon it.

(3) After the kernels are placed roll up the tester and put a rubber band or string around the roll to hold it sufficiently

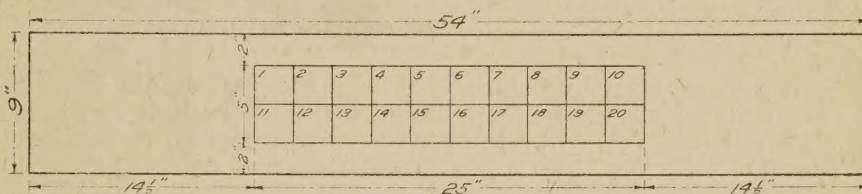


FIG. 2.—Plan for rag-doll tester.

tight that the kernels will be held in place. A number of rolls may be placed on end at once in an ordinary water pail, care being taken to have the kernels pointing down. The pail should be filled with lukewarm water and put away for the seed to soak for five or six hours.

(4) After the rolls of seed have soaked they may be put away in a warm place beneath the folds of clean wet gunny sacks for five or six days. Another method is to place them back in the pail and to tie up the pail full of rolls in paper to keep the seed warm and moist. This method has the advantage that the germinating seed may be soaked again with little trouble if there is a tendency for it to become dry. The seed in a bucket may also be hung where mice will not get at it.

(5) If the seed has been kept warm, germination will have progressed sufficiently on five or six days to indicate its viability and vitality. The cloths should be unrolled carefully so as not to displace the kernels from their squares. A record of the test may be made upon a form similar to the following:

Record of seed test.

Ear No.	Kernels with strong sprouts.	Kernels with weak sprouts.	Kernels with no sprouts.	Remarks.
1				
2				
3				
4				

Corn judging.—This work will involve the following steps: (1) Description of ears, (2) use of score card, and (3) placing of ears according to merit. In order that the students may become familiar with the parts of an ear of corn and the terms used in describing them each student should be required to describe several ears of different types. The following questions will aid the students in their descriptions:

(1) The ear: Is it long, medium, or short? Is it conical, tapering, or cylindrical in shape? Are the tips covered or exposed? Are the butts symmetrical, enlarged, or contracted? (2) The rows: How many? Are they single or arranged in pairs? Is the spacing wide or close? (3) Kernels: Which of the following terms will apply to their shape: Round, square, keystone,

pointed, shoe peg? Are the edges parallel or pointed? Is the crown pointed or smooth? Has it a dimple, a deep dent, or a pinch dent? Are the kernels shallow, medium, or deep? (4) Shank: Is it large, medium, or small?

As preliminary practice to judging each student should be required to score a number of ears. The score card should aid the student in establishing ideals in making more accurate observation and in assigning relative value to points. After the student has developed skill and judgment the card need not be used. The teacher may adapt to his needs any of the cards furnished by the State institutions and those contained in texts and manuals. If the instructor aims to train his students to enter a judging contest, the card used should represent the standard of the institution conducting the contest. It should be borne in mind that these cards represent arbitrary standards. In the past too great a relative weight has been given such fancy points as shape and uniformity. Although such points indicate trueness to type, the farmer is most interested in those points which will indicate whether the seed corn will grow and produce a good crop. In judging emphasis should be placed upon such practical points as maturity, plumpness, and color of kernel, quality of germ, and size of shank, which will indicate viability and adaptation to the locality which produced it. It may be advisable to make up two score cards, one which embodies fancy points which will aid students in their training as judges of corn on exhibition, and one which considers only such practical points as will aid students in selecting seed corn in the field. The latter card should consider the mother plant as well as the ear.

In judging corn by comparison each student should have practice with 10-ear exhibits. To begin this work the student should pick out the best and the poorest ear with respect to a single character; this to be followed by arranging the 10 ears according to merit with respect to the one character. The students may then pick out the best and poorest ears first, considering fancy points only, then all practical points, and finally placing the 10 ears according to merit, considering all points. After the students have become proficient in placing single ears in an exhibit they may place a number of exhibits according to merit. In all judging the student should give definite and concise reasons for his placing.

Contests¹ in corn judging will aid in arousing interest in this work. A local corn show held at the school will not only furnish material for practice in judging but should also do much toward arousing interest in better corn.

HOME PROJECTS.²

In order to connect the work of the school with the work of the farm and put into practice the principles of corn production, each student should be required to produce an acre of corn. The following production projects are suggested: (1) Sweet corn for the market, (2) pop corn for the market, (3) field corn for seed and feed, and (4) corn for soiling or silage. The last-named project would be a good auxiliary project in connection with dairying. As the production of field corn is the most common corn project, this type of corn has been kept in mind in the general outline which follows. The teacher should cooperate with those in charge of the boys' corn clubs. Wherever the club projects may be connected in a definite way with the course in agriculture they may become the home projects of the students.

CORN PROJECT STUDY OUTLINE.

I. Of what economic importance is corn?

1. How does corn compare with other crops in the United States in acreage? In amount produced? In value?
2. How does the United States compare with other nations in the production of corn?
3. How do the six States which lead in corn growing rank in its production?
4. How does this State rank in corn production?
5. What is the production of this county?
6. How does corn compare with other crops in this district?

II. What should I know about the corn plant?

1. What do historians tell us of the origin of corn as a farm crop?
2. What do botanists tell us of the origin and relationship of the corn plant?
3. What are the characteristics of the six principal types of corn?
4. What is the nature and function of the following parts of the corn plant?
(a) Roots, (b) stems, (c) tillers, (d) leaves, (e) flowers, (f) ears.
5. How does a corn plant develop from the seed to maturity?

¹ See U. S. Dept. Agr., Bur. Plant Indus. Circ. 104 (1912), Special Contests for Corn-Club Work.

² For an explanation of home projects and methods of putting the home-project plan into practice, see U. S. Dept. Agr. Bul. 346, Home Projects in Secondary Courses in Agriculture.

III. What conditions are required for corn growing?

1. To what kind of climate is corn best suited?
2. How has corn been adapted to unfavorable climates?
3. What kind of weather is most favorable to the growth of corn?
4. What are the requirements of corn as regards moisture?
5. What types of soil are best suited to corn?
6. Why is corn known as a "gross feeder?"

IV. Shall I grow corn for my project?

1. Is corn a profitable crop in this district?
2. Is my soil suited to corn?
3. Will corn production fit well with my other work and with our general plan of farm management?

V. What shall be my aim in corn production?

1. Shall I grow pop corn or sweet corn for the market?
2. Shall I grow field corn for grain?
3. Shall I aim toward producing seed corn for sale?
4. Shall I grow corn for silage or for silage?
5. How large an area shall I plant?

VI. What care shall I take as to seed for planting?

1. What variety shall I plant?
2. Why is home-grown seed to be preferred?
3. Can I afford to use cheap seed?
4. Do I know the characteristics of good seed corn on the ear and shelled?
5. Which of the following methods of seed selection is to be preferred?
(a) Selecting ears from the crib, (b) selecting ears from the wagon as it comes from the field, (c) selecting ears in the field.
6. What are the essential points to be observed in field selection?
7. Why is it important to select seed corn early?
8. What are the essentials of proper care of seed corn?
9. What is the most satisfactory way for me to cure my seed corn?
10. What method of storing seed corn shall I use?
11. Can I make a rack suitable to my purpose?
12. Have I a place suitable to the storage of seed corn?
13. How may I destroy and guard against mice, weevils, and grain moths?
14. How can I determine the viability of seed corn by examination?
15. What seed corn should be tested before planting?
16. What conditions are essential for a germination test?
17. What kind of seed tester shall I use?
18. Can I make good seed testers?
19. Can I conduct a seed-corn test efficiently?
20. Shall I use a corn sheller or shell my seed corn by hand?

VII. How shall I prepare land for corn?

1. What is the best kind of crop to precede corn in this section?
2. When and how shall I apply manure?
3. What factors will determine the time of plowing?
4. What factors will determine the depth of plowing?
5. Why is deep plowing usually to be preferred?
6. What other preparation will my land need?

VIII. How shall I plant my corn?

1. Shall I plant my corn by hand or hire a planter?
2. What are the comparative values of the following methods of planting: (a) Drilling, (b) check-row planting, (c) listing?
3. Which method is best suited to this section and to my purpose?
4. What is the best time for planting corn in this section?
5. What factors will determine the depth of planting?
6. What factors will determine the distance of planting and the rate of planting?
7. To what extent will the former crop modify the preparation of the land and planting?
8. What shall I do about missing hills?

IX. How shall I cultivate my corn?

1. Why do we cultivate corn?
2. When should cultivation begin?
3. What implements are best suited to early cultivation?
4. What implements serve best for intertillage?
5. What factors will determine the frequency of tillage?
6. What factors determine the depth of early and late cultivation?
7. When should tillage cease?
8. To what extent is hand hoeing profitable?
9. Under what conditions should trimming be practiced?

X. How may I control corn pests?

1. How does corn compare with other crops in regard to pests and diseases?
2. What pests must I guard against in this section?
3. What are the best methods of control of insects which feed below the ground such as the root louse, root-worm, wireworm, and grubworm?
4. How may the presence of such enemies be detected?

X. How may I control corn pests—Continued.

5. How may cutworms, bill bugs, and ear worms be controlled?
6. Is there danger from migratory insects such as chinch bugs, army worms, and grasshoppers? How may such insects be controlled?
7. What measures of control may be applied to the diseases corn smut and ear rot?
8. How may corn be guarded from crows and other birds?
9. How may corn be guarded from ground squirrels and other rodents?

XI. How shall I harvest my corn?

1. When is corn ready to harvest?
2. Can I use the stover at a profit above the cost of harvesting?
3. Will it pay better to turn cattle and hogs in the field for the whole crop or stover?
4. Shall I harvest my crop by hand or hire it done by machinery?
5. Will it pay me to practice topping or stripping?
6. Can I cut, shock, and husk corn efficiently?
7. Have I made proper provision for storing my corn until it is used or sold?
8. Can I measure my field, weigh my corn when cured, and determine the yield accurately and honestly?
9. Can I keep such records that I will know exactly how much it cost to produce my corn and how much I will receive for my labor?
10. Will it pay me better to sell my corn from the field or to store it?

XII. Can I judge corn with efficiency?

1. Do I understand the terms used in describing corn?
2. Of what value is a score card in learning to judge?
3. Should I use the same standard in judging corn for exhibition as in judging corn for seed?
4. What are the requirements for and the relative values of such fancy points as: (a) Shape and proportion of ear, (b) tips, (c) butts, (d) spacing of rows, (e) shape of kernels, (f) uniformity of ear in size, shape, indentation, and kernel?
5. What does a good score in such points indicate?
6. What are the requirements for and the relative values of such practical points as: (a) Maturity, (b) plumpness of kernel, (c) color, (d) quality of germ, (e) size of shank?
7. What does a good score in such points indicate?
8. Can I pick out the best ear in a 10-ear exhibit?
9. Can I place 10 ears according to their merit?
10. Can I give definite, concise reasons for placing single-ear or 10-ear exhibits according to merit?

XIII. What can I do to improve my seed corn?

1. What are the most important laws which underlie the improvement of plants and animals?
2. How does man take advantage of these laws?
3. How may variation be induced in corn?
4. Why is it better to improve a good variety than to attempt to breed a new one?
5. Of what importance are definite aims and ideals in corn breeding?
6. What is the final test of a good ear of seed corn?
7. What is the ear-to-row method of corn breeding?
8. In using this method why should every other row be detasseled?
9. Why would it be preferable to detassel one-half of every other row as opposite ends?
10. Why should the breeding plat be isolated from other corn?
11. Why should all scrubby plants and barren stocks be detasseled?
12. What advantage may there be in reserving a part of each ear planted?
13. At the time of gathering the seed what characters should be noted in the mother plant?
14. What information should be embodied in a record of the breeding plat?

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